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The Conceptual Framework of Design Change Effects in Some Project Delivery Systems

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Abstract. Changes will always occur in project construction and can not be avoided. Many factors can cause changes in the construction project. Most dominant factors of cause of changes in project construction is design change. Design changes will have bad impact on the performance of construction projects, especially the performance of cost and performance time. Many factors can be the cause of design changes. Knowing the factors that cause a design change and knowing its behavior is very important to do. Knowing factor and behavioral of design changes that occur in project construction, and then can be managed properly, it will can be reduce the occurrence of design changes in projects construction. With the reduction of design changes will be able to improve the performance of construction projects, especially at cost and time performance. Construction projects carried out by using a project delivery system. Each project delivery system used will have different contractual relationships, rules, and responsibilities of each party involved. These differences will lead to in the occurrence differences in design change in project construction. Selection of appropriate project delivery system to complete a construction project is needed. The purpose of this paper is to provide a conceptual framework that can be used to determine the behavior, and the effect of design changes on project construction at some project delivery system used.

Introduction.

Changes in construction projects will always occur and can not be avoided [13,15,27].This is because the construction project is very sensitive to changes either due to interference with monetary, fiscal disturbances, lack of time and effective communication, environmental changes, and the increasing complexity of the project[12,22]. Many factors contribute to the changes in project construction such as incomplete information field, incomplete design, design errors, planning and design, underground conditions, security concerns, natural disasters, owner, consultants and contractors, political, economic, natural environment, and third party[11,27,28].
Based on the results of research that has been done, it is said that the design change is the most dominant factor that causes a change in the construction project. So it makes a good design and a little change is one of the key factors that can be done to reduce the changes in the implementation of construction projects [3,7,].To reduce design changes, then the factors that cause design change needs to be known, because by knowing the causes of design changes and can manage these factors, the design changes that will occur in construction projects can be reduced to a minimum.
Many factors can be the cause of design changes. Research conducted by[28]states that the cause of the changes is divided into 2 parts due to internal and external factors. Internal factors are the owner, design consultants, and contractors, while entering into the external factors such as political and economic, natural environment. Causative factors other design changes, among others, owner instructs additional works, owner instructs modification to design, natural growth of the project was not anticipated at the design stage, design errors, the contractor misuses variations instructions, poor

communications between relevant governmental units and the owner, no availability of engineering licensing for engineering, unrealistic design period [1,2,5,6,11,19,23].
Design changes have an adverse effect on the performance of construction projects, such as the performance of the time, cost, quality, productivity, customer satisfaction, health and safety, environmental [15,25,26,18,17]. By knowing and can manage the factors that cause design changes well, it will be able to minimize the occurrence of design changes in projects construction that could further improve the performance of construction projects.
To carry out and complete the project construction used the project delivery system[16]. There are several kinds of project delivery system that can be used to carry out and complete the construction project. Each project delivery system that will be selected each has advantages and disadvantages, this is because each project delivery system has a different impact on the implementation of construction projects such as: project funding, the selection of the parties involved in the project, project cost, quality and time. Thus, the selection of appropriate project delivery system in accordance with the needs of the project construction that will be implemented is required.
The method used in this paper is a literature review the research that has been donepreviously with regard to the issue of changes in the construction project. From the description above, this paper aims to create a conceptual framework that can be used to determine the behavior, caused, and the effect of design changes on project construction at some project delivery system used.

Literatur Riview

The construction project is a series of events that happened only one time to achieve the goals that have been defined in the form of the building, and has a time limit. Construction projects are always changing, it is due to a construction project is very sensitive to changes either due to interference with monetary, fiscal disturbances, lack of time and effective communication, environmental changes, and the increasing complexity of the project[15,14,27,22].
Design changes is becoming the dominant factor that causes change is reinforced by research [3]which states that the two areas of greatest yield deviation is design and construction. From the results of his research, mentioned deviation because design is average 78% of the total amount of deviation that occurs, on average 79% of the total deviation costs incurred, and an average of 9.5% of the total the cost of projects construction. Based on these studies also found that the deviation caused by design two-thirds caused by design change. While research conducted by [7] said claims that occurred in the study 72% due to increase design errors or changes due to owner demand. While 28% claim due to delay, changes in site conditions, administrative errors and so on.
To minimize the occurrence of a change in the implementation of the construction project to minimize design changes is very important to do. Minimize design changes, then determine what are the factors that can lead to design changes need to be made. Based on research conducted by [28] said that the cause of the change in the construction project is divided into 2 parts due to external and internal factors. Where the external factors consist of 1) the political and economic, 2) the natural environment, 3) a third party, while entering into the internal factors are 1) the owner, 2) design consultant, 3) contractors and 4) the other party.
Research conduct by [2]the major causative factors of change. Results of the research done to say the error is a factor contributing to the design changes, followed by poor coordination of design documents. While research conducted by [23]who perform in the state of Alaska from north to south to mention that the root cause of the change in construction projects are 1) changes caused by the engineer, 2) changes due to the user, and 3) differences in site conditions.
In the study mentioned by [11] that the cause of the change consists of two main types of construction needs and administration needs. Construction needs consists of 1) planning and design consists of the design errors and omissions, inconsistencies between drawings and site conditions, defect in design and planning as well as other changes that occur in planning and design. 2) underground condition consists of not enough of field investigations, underground difference condition, there is a flow of underground water, underground approximate difference. 3) safety consideration consists of security considerations in construction projects, 4) consists of the Incident

natural landslide, flooding, soil settlement. While the Administration needs 1) change of rules / regulations consist of rules and regulations change, waste management regulatory changes, changes in regulatory environment problems. 2) change of decision-making authority consists of consideration of political issues, changes to decision makers. 3) commissioning and ownership transfer, the change due to the additional demand associated with the use of projects, security considerations, modifications related maintenance functions and capabilities. 4) Neighborhood pleading, changes due to requests from the community around the project site, such as the addition of facilities for people living around the project, the parts are reduced and the project was canceled due to public demand, a special request from the city council. 5) miscellaneous causes, changes due to coordination with the utility system, conflicts and disputes on construction contracts, the demand from urban planning experts and so on.

Research conduct by [6] on manufacturing projects and look for the factors that cause changes in the project design manufacturing, as well as find how widespread the effects of design changes that occur in the manufacturing project after the contract is signed. The research results are to be obtained factors causing the changes include: 1) designer's omission in tender document, 2) coordination defects in tender document, 3) forced upon from shop drawing coordination, 4) employer has changed his requirement, 5) new information on site existing.

While research conducted by [4]found 10 causes changes in the construction project is owners and construction supervisors : owner request, incomplete design consideration, unclear design, inconsistent design and site, utilities, facility increase, construction conflict, contractor suggestion, people petition, and actual needs. While research conducted by[4]stating the cause of the changes in the construction project is owner’s request, optimistic schedule, omissions-owner, owner’s failure, consultants fail to provide necessary information on time, consultant’s inability, omissions or underestimates consultant, growing needs, stakeholders, others.

Design changes also will give a bad effect on the performance of construction projects such as the performance of the time, cost, quality, environment and so on.Research by [1] mentions that the effect of design changes is a delay in completion of the project, the variations that cause claims and Disputes, cost overrun, the negative effect on the performance and morale of labor, many contractors requesting additional costs due to the variations, causing an adverse effect on the quality of work. While the research conducted[10]said that the changes also provide a very significant impact on the decline in labor productivity and a decrease in labor efficiency.

The effect of the changes by [27] divided into 3 major groups which give effect to time, have an effect on the cost and effect of the relationship and people involved in the project construction. From all the research conducted showed that the effects of changes in costs and changes in time are the most dominant effect occurs when there is design change in the implementation of the project construction.

In the implementation and completion of construction projects typically use a project delivery system. There are several kinds of project delivery system that can be used, where each project delivery system used will have different impacts on design changes. In the conceptual framework to be built here will try to compare some of the project delivery system used in the completion of the construction project. Project delivery system can be classified into several ways. One of the categories used to classify the project delivery system is based on the interaction between design and construction. Based on the interaction between design and construction responsibilities of the project delivery system are grouped into three [20]namely 1) Separated and cooperative, the most widely used example is the design bid build (DBB). 2) Integrated, examples of which are often used include design build (DB), turn key, BOT. 3) Management-oriented, for example, is the construction management (CM), contrancting management and design and manage.

Conceptual Framework Design Change

Based on the results of previous research of design change is the most dominant factor as the cause of changes in the implementation of construction projects. So therefore reduce the occurrence of design changes will result in less change in the construction project.

In order to reduce the occurrence of design changes on implementation of construction projects, the factors that cause changes in the design need to know first. Based on previous research that has been done then the causes of design changes can be classified into internal factors and external factors, where 1) the internal factor is 1.1) owner, 1.2) design consultant, 1.3) construction management consultant, 1.4) contractor, while entering into the 2) external factors 2.1) political and economic, 2.2) the natural environment, 2.3) technological advances and 2.4) third party.
While the attributes of each internal factors are:
1.1) owner consists of: 1.1.1) owner request to make changes, 1.1.2) the owner fails to provide timely decisions, 1.1.3) changes in financing / funding, 1.1.4) the information is incomplete and imprecise 1.1.5) scope of the project is unclear.
1.2) design consultant attributes consists of : 1.2.1) a certificate of expertise / license, 1.2.2) time constraints, 1.2.3) can not provide the information and documents tender complete, 1.2.4) errors and omissions of the consultant design, 1.2.5) the proposed change of design consultants, 1.2.6) are not familiar with the regulations and construction permits, 1.2.7) low of fee to design; 1.2.8) the lack of communication between the design team owner.
1.3) Consultants Construction Management: 1.3.1) fails to communicate with the parties involved in a construction project, 1.3.2) can not provide the right decisions and fast, 1.3.3) does not carefully check and correct the planning documents.
1.4) Contractor: 1.4.1) project implementation time which is not realistic, 1.4.2) implementation of project management undertaken by the contractor is not good, 1.4.3) the contractor requested a change because, improper methods, improving constructability, adjustment of field conditions, 1.4.4) the low bid by the contractor.
While attribute of external factors is:
2.1) Politics and Economics consists of: 2.1.1) changes in government policies and regulations, 2.1.2) changes in decision making authority, 2.1.3) the effect of inflation and fluctuating prices.
2.2) The natural environment consists of: 2.2.1) weather conditions, 2.2.2) natural disasters, 2.2.3) differences in field conditions due to incomplete geological survey and survey field conditions.
2.3) Progress Technology consists of: 2.3.1) design does not fit with today's technology, 2.3.2) information technology and communications systems, 2.3.3) there is a new material
2.4) The third party is made up of: 2.4.1) complaints from parties around the construction project, 2.4.2) requests from parties who will use or which will operate the building.
From the Compilation results of previous studies there are 31 pieces of attributes that can be the cause of design change . If it is known how these attributes leads to changes in the design, then the parties involved in the implementation of construction projects can anticipate and manage these attributes before design change occur, it is expected that the design changes that occur in the implementation of construction projects can be reduced.
Design changes have an adverse effect on the performance of construction projects, such as the performance of cost, time, quality, productivity, customer satisfaction, health and safety, environment. Based on previous research summarized in the research of[26]it can beconcluded that the most dominant effect occurs when there is design change on construction project, is the change in costs and changes in timing at implementation of project construction
There are three important variables, namely changes in design, changes in costs, and changes in time where these variable have a very strong relationship between the one variables with other variables [8,9,11,15,18,21,24,25).
In the implementation of construction projects using project delivery system. Project delivery system will regulate the relationship between the parties involved, the responsibilities of each party involved method of payment, and so on. Each project delivery system that will be selected to have advantages and disadvantages, this is because each different project delivery system has a different impact on the implementation of construction projects. Based on responsibility between design and construction, project delivery system can be used to compare design change at the implementation of project construction. Project delivery system used is a design bid build, design build, and project management.

From the above description, the conceptual framework of the influence of design changes on some project delivery system can be seen in Figure 1.

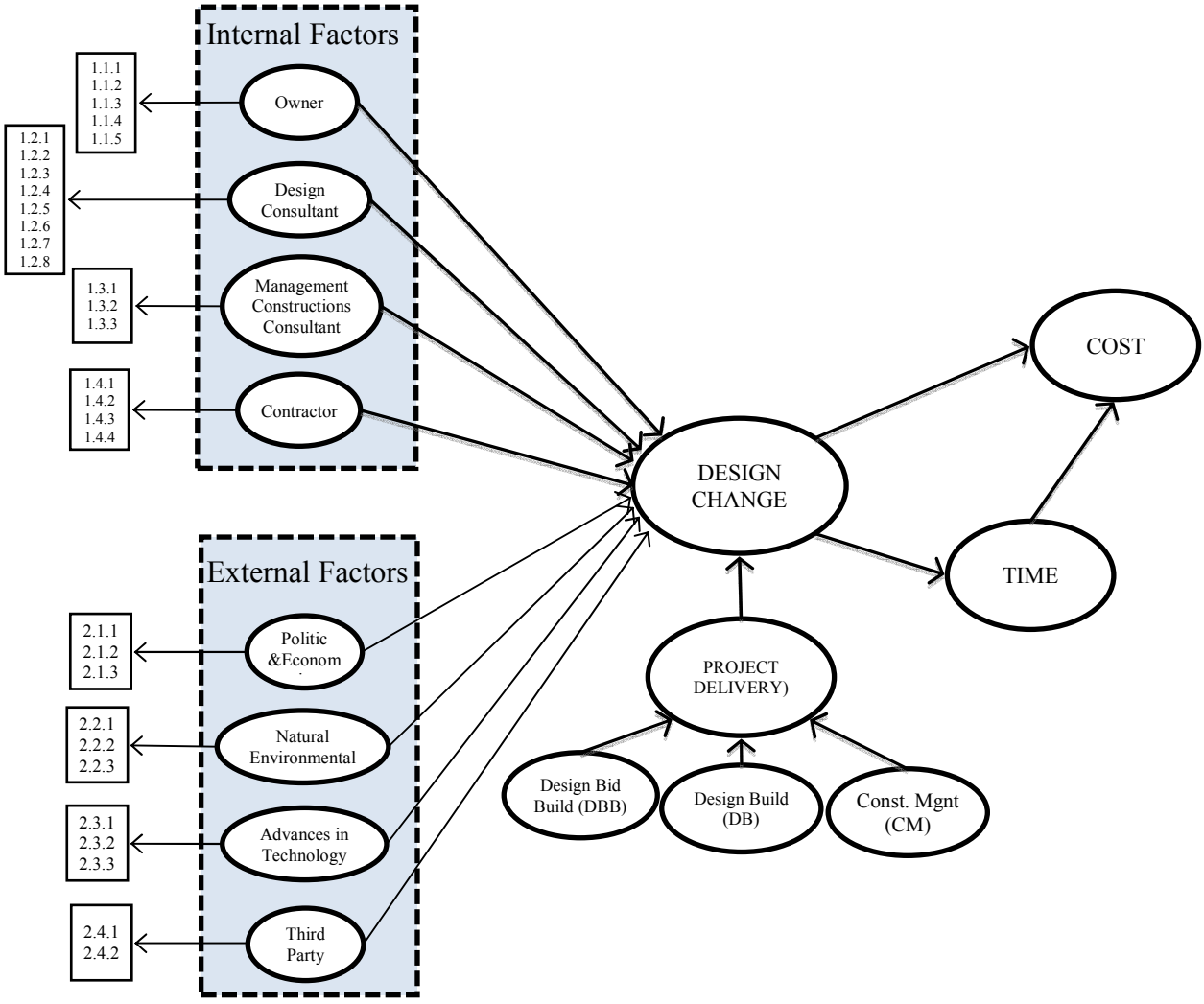

Fig. 1. The Conceptual Framework of Effect of Design Change On Multiple Project Delivery System

From conceptual framework Figure 1 Design Changes on implementation of projects construction caused from the 31 attributes that can be classified into two parts: internal and external factors and consist of 8 factors. While the effects of the most influential event of design changes is the changing costs and changing times. Design changes in addition to causing changes in costs directly also leads to changes in costs over time change. The model of this design change will be seen by using multiple project delivery system in which the design bid build, design build, construction management.

Conclution

Studies conducted here concluded that based on the research that has been done, the strong relationship between design changes with changes in costs and changes in time. This relationship will also be seen in the three project delivery system is used, in order to determine how the effect of the use of the project delivery system to design changes that occur in construction projects. This study is still on going to determine how much influence the design changes to the costs and time on some project delivery system used in the implementation of construction projects.

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